

Appl. No. 10/031,683
Att. Docket No. 10537/195
Response To Office Action of 02/05/04

REMARKS

Claim 6 is canceled without prejudice, and therefore claims 4, 5 and 7 are now pending.

Applicant respectfully requests reconsideration of the present application in view of this response.

With respect to paragraph two (2) of the Office Action, Figure 1 was objected to as not being designated "Prior Art". Figure 1 has been corrected as suggested. Also, Figures 2, 3 and 4 were objected to as to the "7", "8" and "9" designations. These have been corrected to 7a, 7b, 8a, 8b, 9a and 9b, as suggested by the Examiner. The specification has been conformed in this regard. Accordingly, a Second Substitute Specification and a Marked-Up Version thereof (with respect to the previously filed Substitute Specification) accompany this response. No new matter has been added. Approval and entry of the Replacement Drawing sheets for Figures 1, 2, 3 and 4, and of the Second Substitute Specification are respectfully requested.

In accordance with 37 C.F.R. § 1.125, the Second Substitute Specification being submitted (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification to the corrections to the Figures as suggested by the Examiner. As required by 37 C.F.R. § 1.121 and § 1.125, a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Amendment. In the Marked Up Version, underlining indicates added text and "strike-throughs" and double-brackets indicate deleted text. Approval and entry of the Second Substitute Specification (including Abstract) is respectfully requested.

With respect to paragraph four (4), claim 5 was objected to because of a minor informality. In this regard the full feature of claim 5 has been included in claim 7 which is allowable. Claim 5 has been slightly modified since it depends from claim 4, so that it is broader than claim 7. Claim 5 as presented reflects the Examiner's suggestions as to the claim language. Approval is respectfully requested. It is therefore respectfully requested that the objection as to claim 5 be withdrawn.

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With respect to paragraph six (6), claims 4 and 5 were rejected under 35 U.S.C. § 103(a) as unpatentable over Applicant's "admitted prior art" in view of Culliinane et al., U.S. Patent No. 6,178,983.

While the rejections may not be agreed with, to facilitate matters, claim 4 now includes the feature of claim 6, which was objected to, so that claim 4 is allowable. Claim 6 has been canceled without prejudice. As regards claim 5, it has been slightly modified since it depends from claim 4, so that it is broader than claim 7. Claim 5 as presented reflects the Examiner's suggestions as to the claim language. It is therefore respectfully submitted that claims 4 and 5 are allowable.

With respect to paragraph seven (7), the Office Action indicated that claims 6 and 7 include allowable subject matter. In this regard, claim 4 as presented now includes the feature of claim 6, which has been canceled. Claim 7 has been rewritten as an independent claim to include the features of claims 4 and 5, so that claim 7 is allowable. It is therefore respectfully requested that the objections be withdrawn.

Accordingly, claims 4, 5 and 7 are allowable.

CONCLUSION

In view of the foregoing, it is believed that the objections and rejections have been obviated, and that claims 4, 5, and 7 are allowable. It is therefore respectfully requested that the objections and rejections be withdrawn, and that the present application issue as early as possible.

Respectfully submitted,
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EXTINGUISHER

FIELD OF THE INVENTION

The present invention relates to an extinguisher for fighting fire and incipient explosions, the extinguisher including at least one rupture diaphragm, which seals an extinguishing-agent vessel and has a rupture joint.

BACKGROUND INFORMATION

To fight fire and suppress incipient explosions which are caused by flour dust, coal dust, or solvent vapors, one normally uses vessels that are filled with an extinguishing agent (usually extinguishing powder) and are permanently under pressure. In an emergency, these blow the extinguishing agent through a quick-opening valve, into the space where extinguishing is required.

An extinguisher for fighting incipient explosions is described in German Published Patent Application No. 195 44 399, where a tubular extinguishing-agent vessel is sealed on the inside and outside by flat rupture diaphragms. In the interior chamber adjacent to the inner rupture diaphragm, a compressed-gas generator is provided, the generated propellant gas of which ruptures the diaphragms and then expels the extinguishing agent. This extinguisher does not often achieve good results, since the rupture diaphragms seldom burst open in the center, or in an axially symmetric manner. Instead, the diaphragms rupture at a point outside their center, which causes the expelled extinguishing agent to be dispersed in a considerably asymmetric manner. However, it is necessary to expel all of the extinguishing agent in a uniform manner, in order to

attain an optimum spray pattern and, thus, success in extinguishing.

In addition, German Published Patent Application No. 42 24 184 describes an extinguisher, where the extinguishing-agent vessel is sealed on the outside by a convex rupture diaphragm, which is provided with circular and radial rupture joints. This diaphragm already opens at a pressure of 0.1 to 1.0 bar above atmospheric pressure. Connected to the extinguishing-agent vessel is a compressed-gas generator, which, in response to being triggered, mixes the extinguishing agent together with the compressed gas and sprays this mixture into the space where the extinguishing is to take place. In order for the extinguishing agent to have a rapid effect, it may be more favorable for the extinguishing agent to only be dispersed after it is expelled from the vessel. The shape of the diaphragm used also does not allow one to compensate for the change in the extinguishing-agent volume as a function of the temperature.

Other conventional extinguishers include rupture diaphragms that are spherically shaped so as to be inwardly concave in the direction of the compressed-gas generator, and are provided with a rupture joint. These rupture diaphragms bulge in response to pressure applied by the gas generator or thermally induced expansion, at some point that, generally, is not at the center of the diaphragms, but rather at an arbitrary position on the spherical diaphragm surface. The bulge extends to the other side in the form of an inversion and results in a rupture joint rupturing off-center. This causes the extinguishing agent to be discharged in a nonuniform manner.

Therefore, it is an object of the present invention to provide a rupture diaphragm for an extinguisher of the type mentioned above, so as to eliminate the above-mentioned disadvantages and cause the rupture diaphragm to burst open in the center, and thus uniformly disperse the extinguishing agent.

SUMMARY

The foregoing object is achieved by providing an extinguisher as described herein. An advantage of the rupture diaphragm according to the present invention is that the planar surface or the depression in the center of the rupture diaphragm allows the diaphragm to be easily inverted in the case of pressure being applied, without local bulging occurring. In this context, the rupture diaphragm behaves like a cup spring. In addition, the rupture diaphragm configured according to the present invention may compensate for thermal expansion of the extinguishing agent, since the planar surface or the depression in the center of the diaphragm is elastic in its movement in the axial direction.

A further advantage results from the circular shape of the planar surface in the center of the rupture diaphragm, in that a uniform load distribution is achieved in response to an applied pressure. This supports a uniform inversion of the diaphragms and prevents them from bulging on the side. The inverting procedure causes the rupture joint provided on the edge of the rupture diaphragm to weaken prior to breaking, so that the actual rupturing event occurs simultaneously on the entire circumference, and the extinguishing agent is expelled in a uniform manner.

An example embodiment of the extinguisher according to the present invention is described in detail below and is

illustrated in the drawing in a schematically simplified manner.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1 schematically illustrates an extinguisher having concave diaphragms according to the related art.

Fig. 2 is a schematic cross-sectional view of an extinguisher cartridge having a planar center of the diaphragm.

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Fig. 3 is a schematic cross-sectional view of an extinguisher cartridge having a central depression.

Fig. 4 is a schematic view of an inverted rupture diaphragm.

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DETAILED DESCRIPTION

Illustrated in Fig. 1 is an extinguisher 1, which is constructed in a conventional manner and contains a pyrotechnic gas generator 2. Rupture diaphragms 3 and 4, which are concave with respect to pyrotechnic gas generator 2, i.e., curved in the direction of the gas generator, seal extinguishing-agent cartridge 5 so that extinguishing agent 6 cannot escape. Rupture diaphragms 3 and 4 are spherically shaped and have rupture joints in their diaphragm surfaces.

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In the case of pressure being applied, such rupture diaphragms bulge at some randomly determined point or at a weak point in the material. In the case of a distinct bulge, the nearest rupture joint begins to break.

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In order to prevent such an occurrence, the present invention provides forming the rupture diaphragms in a manner illustrated in Fig. 2. In this case, the center of rupture diaphragms 7a and 7b is in the form of a flat surface.

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**MARKED UP VERSION OF SECOND
SUBSTITUTE SPECIFICATION**

Situated at the edge of rupture diaphragm 7b is the rupture joint 8b that is impressed about the circumference.

Temperature-dependent volume fluctuations are compensated for with the aid of the central, planar surface, by its elastic movement in the direction of main axis A of extinguisher 1.

In the case of compressed-gas generator 2 being triggered, the two diaphragms 7a and 7b are simultaneously inverted, and the rupture joints 8a and 8b weakened by the inversion pull apart.

As illustrated in Fig. 3, rupture diaphragms 9a and 9b are configured to be convex in their central region, i.e., curved away from the compressed-gas generator. This shape of the diaphragms has a positive effect in centrally focusing the pressure applied by gas generator 2.

Fig. 4 illustrate the procedure of inverting the two rupture diaphragms 7a and 7b illustrated in the resting state in Fig. 2, by the action of the applied gas pressure (arrows). During the inversion procedure, rupture joints 8a and 8b are first subjected to lateral flexure and then tensile stress. The rupture simultaneously occurs along the rupture line of the two rupture joints 8a and 8b. The resting position of right rupture diaphragm 7b is indicated in Fig. 4 by a dashed line.

ABSTRACT

An extinguisher includes a compressed-gas generator for fighting fire and incipient explosions, and the extinguisher includes at least one rupture diaphragm having a rupture joint, in order to seal the extinguishing-agent vessel. In its center, the rupture diaphragm has a planar surface or a depression, which causes the rupture joint to simultaneously open at its entire circumference, in order for the extinguishing agent to escape in an axially symmetric manner.